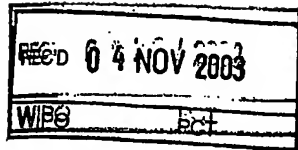


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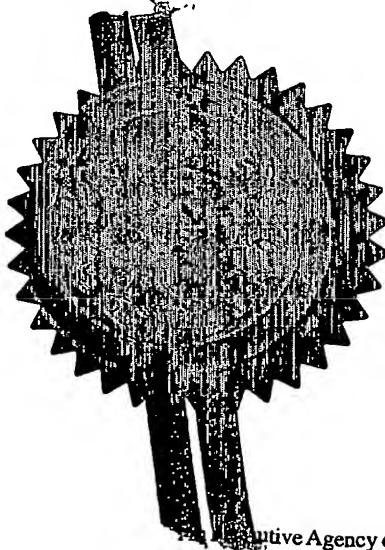
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Cardiff Road  
Newport  
South Wales  
NP10 8QQ

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

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Signed

*W. Evans*

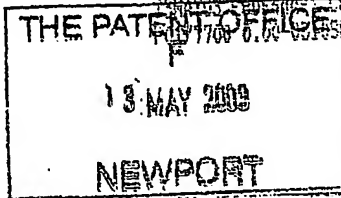
Dated - 21 October 2003

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Patent Act 1977  
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The Patent Office  
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NP10 8QQ

**Request for grant of a patent**

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

1. Your reference

EATAIR 2

2. Patent application number

(The Patent Office will fill in this part)

0310889.1

3. Full name, address and postcode of the or of each applicant (underline all surnames)

E. A. TECHNICAL SERVICES LTD

08306474001

Patents ADP number (if you know it)

If the applicant is a corporate body, give the country/state of its incorporation

9 RYDAL PLACE  
CLITHEROE ROAD  
CLITHEROE  
LANCASHIRE  
BB74JY

4. Title of the invention

AIR CYCLE HEATING AND COOLING

5. Name of your agent (if you have one)

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

Patents ADP number (if you know it)

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number

Country

Priority application number  
(if you know it)

Date of filing  
(day / month / year)

0222770.0

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing  
(day / month / year)

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:

- a) any applicant named in part 3 is not an inventor, or
  - b) there is an inventor who is not named as an applicant, or
  - c) any named applicant is a corporate body.
- See note (d))

YES

Patents Form 1/77

**Patents Form 1/77**

9. Enter the number of sheets for any of the following items you are filing with this form.  
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Continuation sheets of this form

Description

1 /

Claim(s)

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Abstract

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Drawing(s)

6 /

10. If you are also filing any of the following, state how many against each item.

Priority documents

Translations of priority documents

Statement of inventorship and right to grant of a patent (Patents Form 7/77)

Request for preliminary examination and search (Patents Form 9/77)

Request for substantive examination (Patents Form 10/77)

Any other documents  
(please specify)

11.

I/We request the grant of a patent on the basis of this application.

Signature

*Ron Driver*

Date

12 MAY 2003

12. Name and daytime telephone number of person to contact in the United Kingdom

RON DRIVER

01200 441492

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**Notes**

- If you need help to fill in this form or you have any questions, please contact the Patent Office on 08459 500505.
- Write your answers in capital letters using black ink or you may type them.
- If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.
- If you have answered 'Yes' Patents Form 7/77 will need to be filed.
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- Patents Form 1/77

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## AIR CYCLE HEATING AND COOLING

In the present invention it is proposed to use a rolling piston compressor and expander of the type described in PCT/GB01/03089 and PCT/GB 03/00194 and GB2364552 and use air as the working fluid as described in application GB 0222770.0.

One machine can act as a compressor while the other can act simultaneously as a turbine providing the expansion, or both can act simultaneously as compressors or turbines. Two machines can be fitted together so that any out of balance forces can oppose each other resulting in a pair of machines that do not require specific balancing features.

The machines cited above can rotate over a wide speed range. With a defined running clearance and pressure ratio, fluid leakage is a higher percentage of total fluid flow at low speed than at high speed. To reduce leakage, particularly at low speed, without resorting to small manufacturing tolerances, it is proposed to apply a compliant polymer to the surface of the rolling piston. In the present invention it is proposed to reduce the weight and manufacturing difficulty of the rolling piston by permitting it to be made from an extrusion with compliant polymer strips. The strips are spaced apart sufficiently to ensure there is always at least one strip in contact with the casing bore for the majority of the fluid compression or expansion phase. The strips are fitted in slots in the periphery of the rolling piston and may have a dovetail shape.

Figure 1 shows a typical rolling piston with typical compliant polymer strips. With a rolling piston diameter of 125 mm and casing bore of 150 mm the required number of polymer strips is approximately 18.

Figure 2 shows the relationship of the rolling piston and rotating side discs.

Figure 3 shows the relationship of the rolling piston and casing bore at one instance.

Figure 4 shows two machines attached together viewed from the drive side.

Figure 5 shows two machines attached together from another perspective.

Figure 6 shows the rotor assembly and its offset shaft that locates the rolling piston and the fluid exit and entry features.

# Rolling Piston with Multiple Compliable Polymer Strips

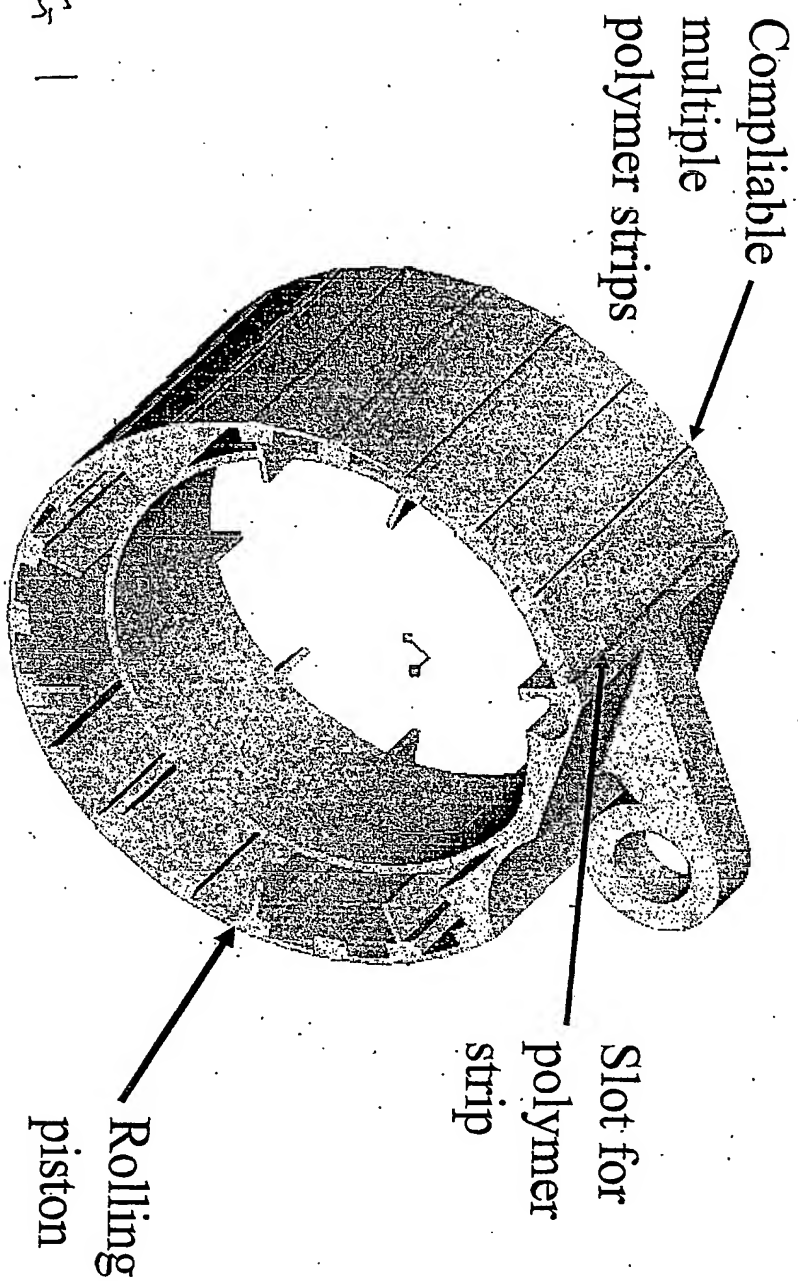


Fig. 1

View showing the relationship of the rolling piston and  
rotating side discs

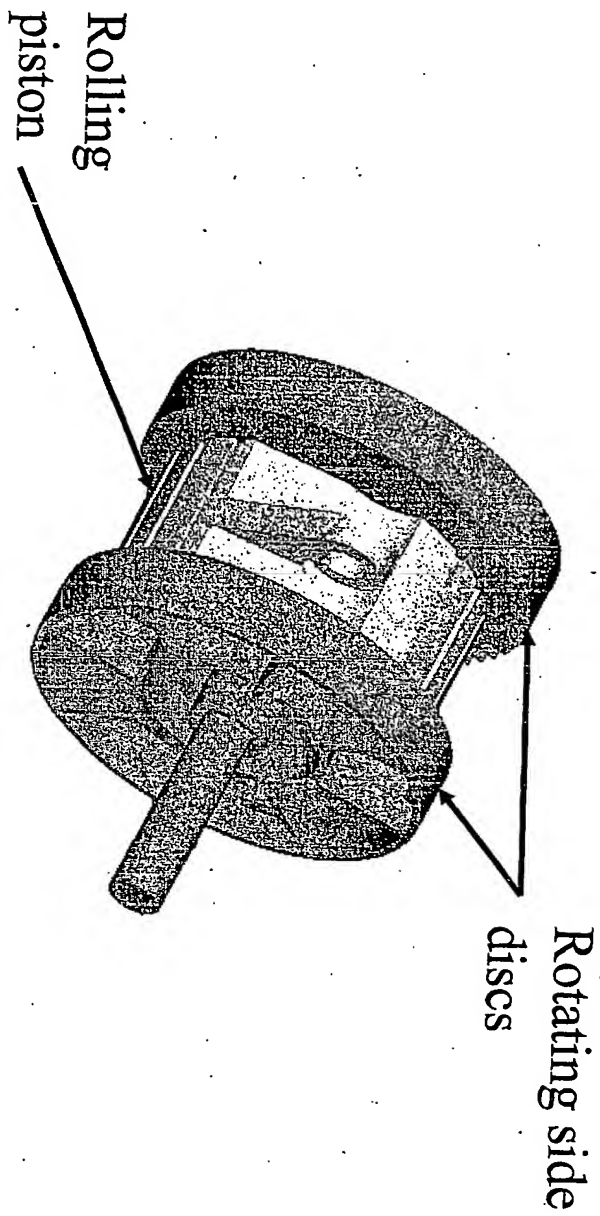


FIG 2

Supercharger/Throttle Loss Recovery Machine Partly Assembled View on  
the Drive Side

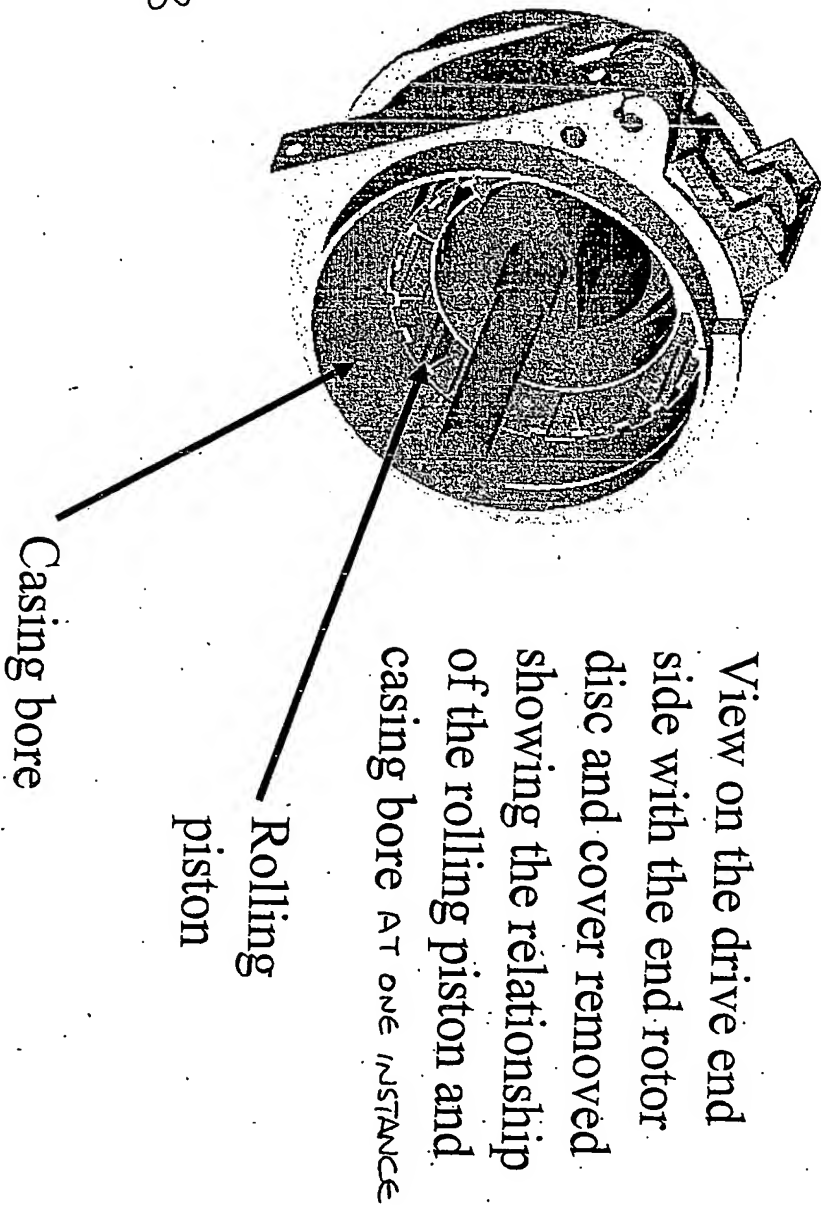


Fig 3

Twin Pair of Supercharger/Throttle Loss Recovery Machines one Fully  
Assembled and one Partly Assembled View on the Drive Side

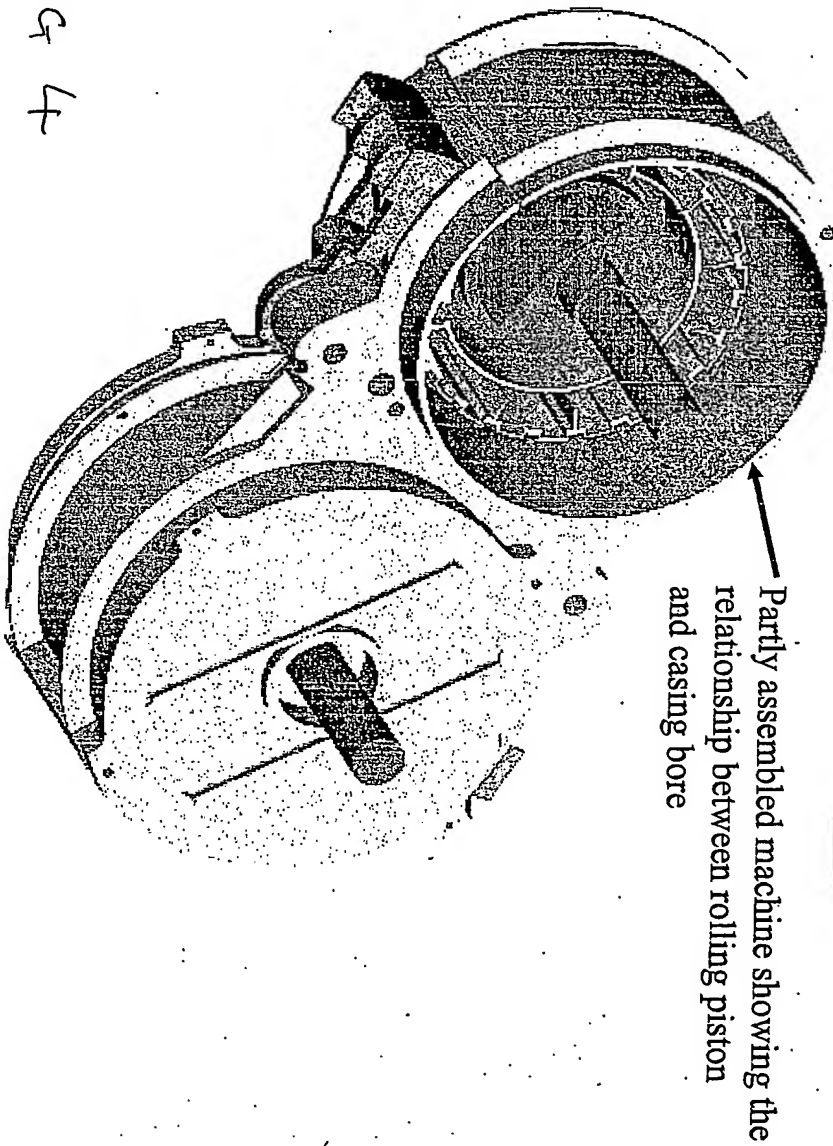


FIG 4



Twin Pair of Supercharger/Throttle Loss Recovery Machines one Fully  
Assembled and one Partly Assembled View on the End Opposite the  
Drive Side

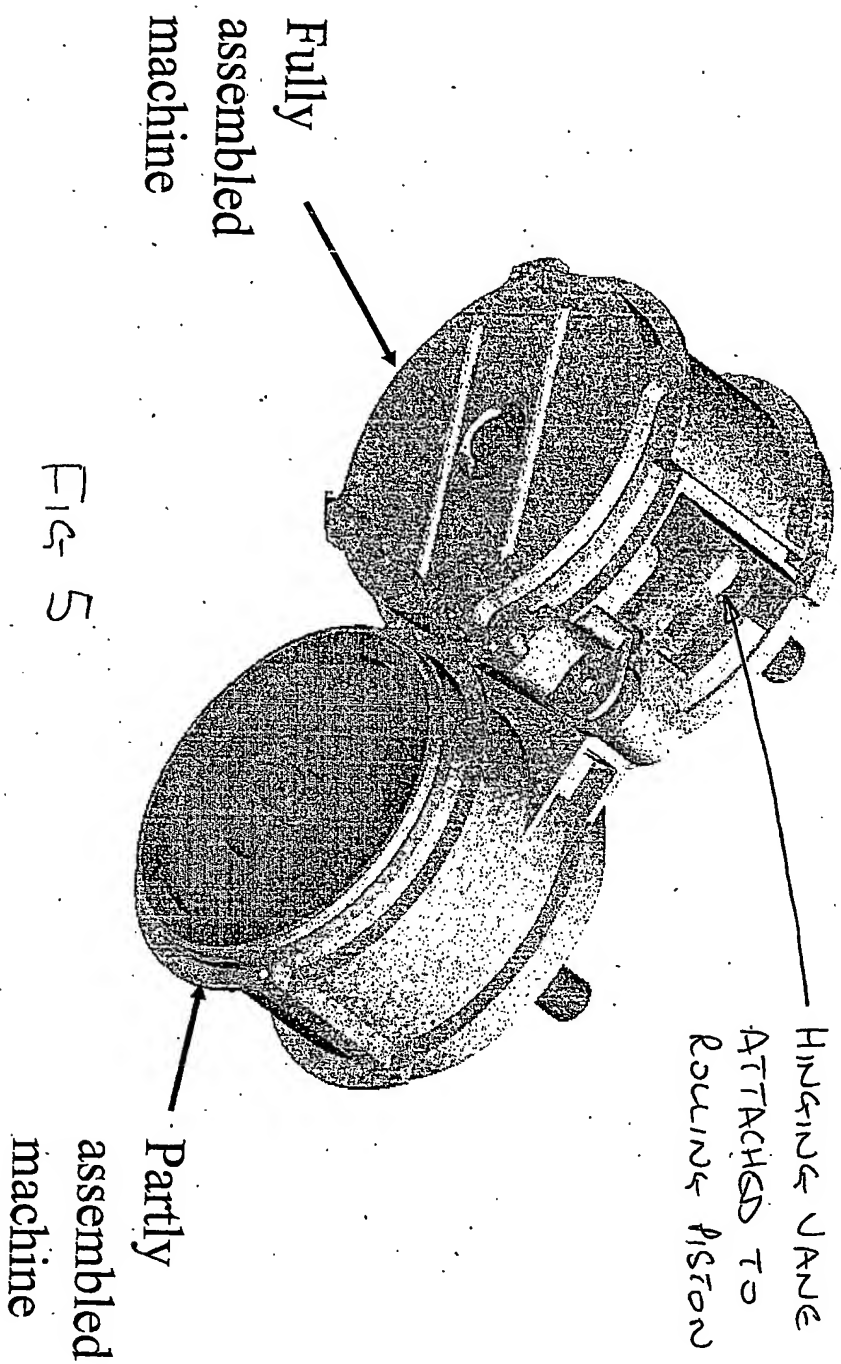


FIG 5

# Rotor Assembly

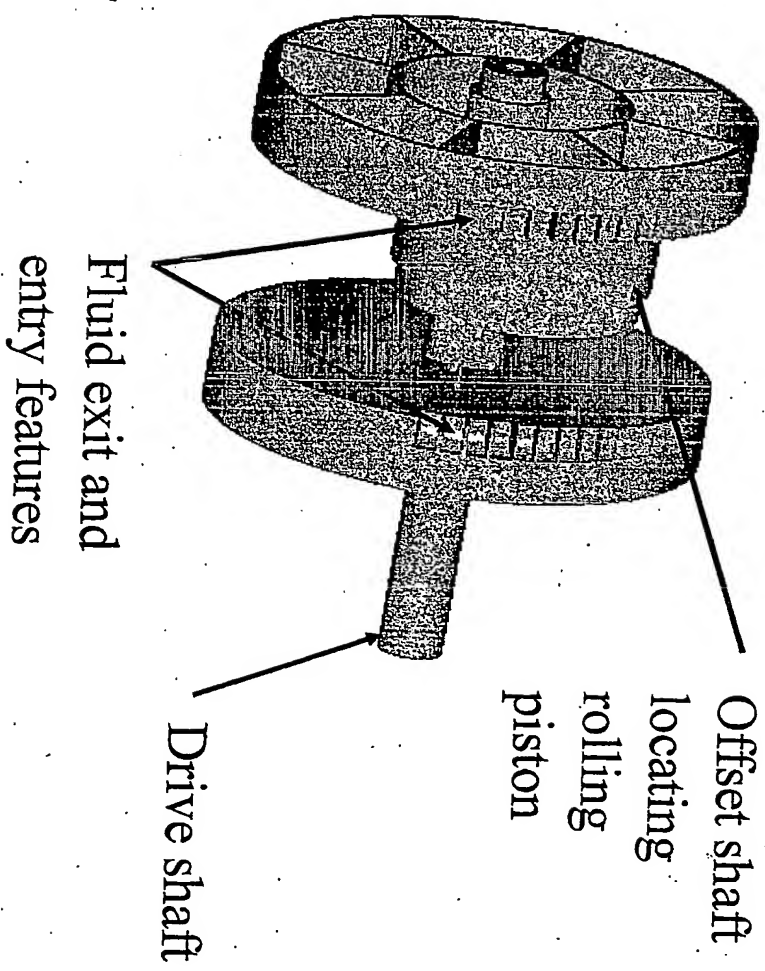


Fig 6